

## REMARKS

Claims 1, 7, 9, 11-13, 16-18, 22, 24 and 27-32 are pending in the present application for further prosecution. Independent claims 1, 7 and 27 have been amended to distinguish over the prior art of record. No new matter was added. Accordingly, Applicant respectfully submits that claims 1, 7, 9, 11-13, 16-18, 22, 24 and 27-32 are in condition for allowance.

### **I. Claim Rejection - 35 USC §103(a)**

- A. *In the non-final Office Action dated February 3, 2010, claims 1, 9, 22 and 27-31 are rejected under 35 USC §103(a) as being obvious over U.S. Patent Application No. 2004/0222088 A1 of Subramani et al. in view of U.S. Patent No. 6,139,701 issued to Pavate et al. with additional evidence provided by U.S. Patent No. 5,632,869 issued to Hurwitt et al.*

Applicant respectfully submits that claims 1, 9, 22 and 27-31 are patentable over the prior art of record for the reasons set forth below. Accordingly, Applicant respectfully requests reconsideration and removal of the above stated rejection.

With respect to the primary reference, Subramani et al., Applicant respectfully submits that this reference fails to disclose a “hollow cathode sputtering target comprising an inner bottom face that forms a non-erosion portion of a plastic-worked hollow cathode sputtering target and a cylindrical inner peripheral face that forms an erosion portion of the plastic-worked hollow cathode sputtering target” as required by independent claim 1 of the present application.

Further, independent claim 27 has been amended to require “a hollow cathode sputtering target, consisting of: a cup-shaped body having an inner peripheral surface defining a hollow cavity within the cup-shaped body and an outer peripheral surface on an exterior of said cup-shaped body, said inner peripheral surface being a sputtering face of said cup-shaped body and said outer peripheral face being a non-erosion face; said inner peripheral surface consisting of a cylindrical peripheral face, a bottom face, and a curved face defining a boundary between said

cylindrical face and said bottom face, said cylindrical peripheral face forming an erosion area of said sputtering face that is eroded during a sputtering operation when a high density plasma is generated within the hollow cavity of the cup-shaped body, and said bottom face forming a non-erosion portion of said cup-shaped body”. Applicant respectfully submits that the Subramani et al. publication is being misinterpreted and fails to disclose the claimed structure.

Paragraph No. 0021 of Subramani et al. clearly discloses the structure of the target (111). It includes cylindrical outer and inner sidewalls (4, 6), an annular top wall (5), and a circular top wall (9). See FIG. 1A of the Subramani et al. publication. The target (111) provides an “inverted annular trough 8”. Accordingly, the target (111) disclosed by Subramani et al. is not “cup-shaped”; rather, it has an annular or doughnut shaped trough (8). Further, Paragraph No. 0021 clearly states that surfaces of all the cylindrical outer and inner sidewalls (4, 6), the annular top wall (5), and the circular top wall (9) comprise “the sputtering material to be sputtered on the substrate 104”.

Applicant respectfully submits that the annular trough sputtering target (111) of Subramani et al. neither discloses nor renders obvious the cup-shaped sputtering target required by the claims of the present application, particularly the limitations recited by the close-ended language (“consisting of”) provided by independent claim 27, as amended. In addition, the functionality of the target of Subramani et al. is entirely different to that of the target according to the present invention. The claims of the present application make clear that the entire inner bottom face of the cup-shaped target is a non-erosion portion of the target; whereas, in contrast, Subramani et al. require all surfaces, including annular top wall (5) and circular top wall (9) to comprise “the sputtering material to be sputtered on the substrate”. Thus, teachings provided by Subramani et al. do not correspond or render anything obvious to one of ordinary skill in the art relative to the different target structure of the present invention.

For at least this reason, Applicant respectfully requests reconsideration and removal of the above stated rejection of claims 1, 9, 22 and 27-31.

Moreover, independent claims 1 and 27 of the present application have been amended to further distinguish over the cited prior art. For example, claim 1, as amended, of the present application requires “wherein, upon manufacture, a surface roughness (Ra) of said inner bottom face ... being Ra=1.0 $\mu$ m and being equal to or less than a surface roughness (Ra) of said cylindrical inner peripheral face”. Independent claim 27 has been amended in a similar manner.

No new matter was added. For example, see page 5, lines 18-26, of the present application, as filed. With respect to the specific language “upon manufacture”, see page 5, line 18. Further, compare the left-hand sides of the graphs of FIGs. 2-5 and the discussion thereof provided with respect to the examples and comparative examples on pages 6-10 of the present application, as filed. The sputtering targets made according to the present invention produced significantly less undesired particles during sputtering (see FIGs. 3 and 5) and provide enhanced uniformity “from the initial stage” of sputtering (see FIGs. 2 and 4).

This is clearly not disclosed, taught, suggested, or rendered obvious by the prior art of record. For example, in the Office Action dated February 3, 2010, the Examiner admits that:

“It should be noted that Subramani in view of Pavate discloses a polished target in which the entire target has an equally low surface roughness **before use**.”

It is then reasoned that the sputtering surfaces of the target would be roughened by removal of target material during sputtering “as evidenced by Hurwitt”.

Applicant respectfully requests reconsideration based on the above referenced amendments made to independent claims 1 and 27 of the present application. The claimed targets require the surface roughness limitations to be possessed by the target “upon manufacture”. The unexpected benefit provided by the claimed target configuration is that the

target produces fewer particles and provides greater uniformity at the initial stage of sputtering. This is simply not fairly disclosed or rendered obvious by the cited prior art, especially considering it is conventional practice to roughen the inner bottom face of cup-shaped hollow cathode sputtering targets so that the inner bottom face functions as a “getter”.

Accordingly, for at least this additional reason, Applicant respectfully requests reconsideration and removal of the above stated rejection of claims 1, 9, 22 and 27-31.

Still further, the present invention provides a hollow-cathode-type sputtering target in which, by adjusting the surface of the so-called “non-erosion face” that is not subjected to sputtering during a sputtering operation, the peeling of a film (re-deposited film) that deposits on the “non-erosion face” can be considerably reduced. For example, compare the results reported in FIGs. 2-5 of the present application, as filed. With the hollow cathode-type sputtering target of the present invention, the “non-erosion face” is the inner bottom face, and by adjusting surface roughness Ra of the inner bottom face to 0.1  $\mu\text{m}$  or less, the peeling of the re-deposited film that becomes deposited on the inner bottom face is considerably reduced.

The primary reference, Subramani et al., fails to provide any meaningful description concerning the surface roughness of the hollow cathode-type sputtering target as claimed by the present application. Subramani et al. disclose a sputtering target having an annular or doughnut shaped trough in which all surfaces, including the inner annular bottom face, is an erosion-portion of the target. Paragraph No. 0034 of Subramani et al. merely discloses that the electroplated layer of the target “may be further machined” for purposes of providing the “desired target dimensions” and a “smooth surface” (24). However, no meaning is prescribed to what is meant by “smooth”, and all surfaces of the target form erosion-portions of the target.

The secondary reference, Pavate et al., discloses adjusting the surface roughness of the “face to be sputtered”. However, Pavate et al. fail to disclose adjusting the surface roughness of

the “non-erosion face” that is not subjected to sputtering. The reason that the surface roughness of the “face to be sputtered” is adjusted is to prevent fluctuation of the magnetic field and formation of splats, and thereby obtain favorable sputtering characteristics. Accordingly, neither Subramani et al. nor Pavate et al. provide any perspective on adjusting surface roughness of the “non-erosion face” of the target that is not subjected to sputtering. Thus, even in the event that one of ordinary skill in the art combined the teachings of Subramani et al. with the teachings of Pavate et al., the invention as now claimed in claims 1 and 27 of the present application would not be obvious to one of ordinary skill in the art because nothing is taught with respect to the non-erosion face. Further, conventional teaching with respect to “non-erosion” faces of targets is to make them rougher so that they function as a “getter” as previously argued by Applicant.

Finally, Hurwitt provides a disclosure only with respect to the condition of the surface of a sputtering target after a sputtering operation is performed, not before or upon manufacture. Further, Hurwitt only discusses the “erosion portion” of the target and discloses nothing with respect to the surface roughness of the “non-erosion portion” of the target. Thus, even in the event that one of ordinary skill in the art combined the teachings of Subramani et al. with the teachings of Pavate et al. with evidence from Hurwitt, the invention as now claimed in claims 1 and 27 of the present application would not be obvious to one of ordinary skill in the art.

Accordingly, for all the above stated reasons taken separately or in conjunction, Applicant respectfully submits that claims 1, 9, 22 and 27-31 of the present application are patentable and are not obvious over the Subramani et al., Pavate et al. and Hurwitt et al. combination.

*B. In the non-final Office Action dated February 3, 2010, claims 1, 9, 22 and 27-31 are rejected under 35 USC §103(a) as being obvious over U.S. Patent Application No. 2004/0222088 A1 of Subramani et al. in view of U.S. Patent No. 6,153,315 issued to Yamakoshi et al. with additional evidence provided by U.S. Patent No. 5,632,869 issued to Hurwitt et al.*

Applicant respectfully submits that the same reasons that independent claims 1 and 27 are patentable over the Subramani et al., Pavate et al. and Hurwitt et al. combination also applies with respect to the Subramani et al., Yamakoshi et al. and Hurwitt et al. combination. Thus, Applicant respectfully requests the Examiner to consider the arguments and claim amendments discussed above for a response to this rejection.

Similar to Pavate et al. (discussed above), Yamakoshi et al. disclose adjusting the surface roughness of the “face to be sputtered” and fail to disclose adjusting the surface roughness of the “non-erosion” face. The reason that the surface roughness of the “face to be sputtered” is adjusted is to prevent the formation of nodules on the face to be sputtered as a result of continued sputtering. Accordingly, similar to Subramani et al., Pavate et al., and Hurwitt et al., Yamakoshi et al. fail to provide any relevant teaching to one of ordinary skill in the art with respect to adjusting the surface roughness of the “non-erosion” face of the target that is not subjected to sputtering.

Accordingly, for all the above and previously stated reasons taken separately or in conjunction, Applicant respectfully submits that claims 1, 9, 22 and 27-31 of the present application are patentable and are not obvious over the Subramani et al., Yamakoshi et al. and Hurwitt et al. combination.

C. *In the non-final Office Action dated February 3, 2010, claims 11-13 and 16-18 are rejected under 35 USC §103(a) as being obvious over U.S. Patent Application No. 2004/0222088 A1 of Subramani et al. in view of U.S. Patent No. 6,139,701 issued to Pavate et al. in further view of U.S. Patent Application No. 2002/0079217 A1 of Buehler.*

The deficiencies of Subramani et al. in view of Pavate et al. relative to the limitations of claim 1 of the present application are discussed above in detail.

The secondary reference, Buehler, merely discloses the use of imprints on non-erosion sidewall surfaces of a sputtering target to “retain redeposited material” to “prevent flakes of the redeposited material from falling off” the non-erosion surfaces during a sputtering operation. These imprints, of course, intentionally roughen the non-erosion portions and such surfaces would not have the surface roughness (Ra) required by the claims of the present application. Further, it is clear that one of ordinary skill in the art following the teachings of Buehler would roughen all non-erosion target surfaces, including the inner bottom face of a hollow body target. Thus, Buehler teaches away from the requirements in the claims of the present application.

Accordingly, Applicant respectfully submits that for the same reasons discussed above with respect to the rejection based on Subramani et al. in view of Pavate et al., claims 11-13 and 16-18 are patentable and non-obvious relative to Subramani et al. in view of Pavate et al. and further in view of Buehler. Accordingly, Applicant respectfully requests reconsideration and removal of the rejection.

D. *In the non-final Office Action dated February 3, 2010, claims 11-13 and 16-18 are rejected under 35 USC §103(a) as being obvious over U.S. Patent Application No. 2004/0222088 A1 of Subramani et al. in view of U.S. Patent No. 6,153,315 issued to Yamakoshi et al. in further view of U.S. Patent Application No. 2002/0079217 A1 of Buehler.*

The deficiencies of Subramani et al. in view of Yamakoshi et al. relative to the limitations of claim 1 of the present application are discussed above in detail.

The secondary reference, Buehler, discloses the use of imprints on non-erosion sidewall surfaces of a sputtering target to “retain redeposited material” to “prevent flakes of the redeposited material from falling off” the non-erosion surfaces during a sputtering operation. These imprints, of course, intentionally roughen the non-erosion portions and such surfaces would not have the surface roughness (Ra) required by the claims of the present application. Further, it is clear that one of ordinary skill in the art following the teachings of Buehler would roughen all non-erosion target surfaces, including the inner bottom face of a hollow body target. Thus, Buehler teaches away from the requirements in the claims of the present application.

Accordingly, Applicant respectfully submits that for the same reasons discussed above with respect to the rejection based on Subramani et al. in view of Yamakoshi et al., claims 11-13 and 16-18 are patentable and non-obvious relative to Subramani et al. in view of Yamakoshi et al. and further in view of Buehler. Accordingly, Applicant respectfully requests reconsideration and removal of the rejection.

*E. In the non-final Office Action dated February 3, 2010, method claims 7, 24 and 32 are rejected under 35 USC §103(a) as being obvious over U.S. Patent Application No. 2004/0222088 A1 of Subramani et al. in view of U.S. Patent No. 6,153,315 issued to Yamakoshi et al. in further view of U.S. Patent No. 6,283,357 B1 issued to Kulkarni et al. with additional evidence provided by U.S. Patent No. 5,632,869 issued to Hurwitt et al.*

Independent method claim 7 of the present application has been amended similar to claim 1 discussed above in detail. Thus, the method steps with respect to surface roughness are “upon manufacture”.

Accordingly, Applicant respectfully submits that for the same reasons discussed above with respect to the rejection of claim 1 based on Subramani et al. in view of Yamakoshi et al. and Hurwitt et al., claims 7, 24 and 32 are patentable and non-obvious relative to Subramani et al. in



view of Yamakoshi et al., Hurwitt et al. and Kulkarni. Accordingly, Applicant respectfully requests reconsideration and removal of the rejection.

## **II. Conclusion**

In view of the above amendments and remarks, Applicant respectfully submits that the claim rejections have been overcome and that the present application is in condition for allowance. Thus, a favorable action on the merits is therefore requested.

Please charge any deficiency or credit any overpayment for entering this Amendment to our deposit account no. 08-3040.

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